Attachment 3
Response to Comments and Questions Raised at the March 2007
Central Valley Water Board Workshop on the Delta Methylmercury TMDL

Introduction

The Central Valley Water Board held a public workshop on 16 March 2007 to discuss the development of an amendment to the Water Quality Control Plan (Basin Plan) for the control of methyl and total mercury in the Sacramento-San Joaquin Delta Estuary. Board members and the public had comments and questions that required more explanation than time allowed during the workshop. This document lists some of the major questions and comments that arose during the workshop (in bold text) followed by responses written by Water Board staff. The full Basin Plan amendment staff report provides details on the approach to control methylmercury, staff recommendations for the control program, and additional information that addresses the workshop comments.

1. Is there a mercury problem in the Delta? 2
2. What factors guide the selection of a fish tissue objective that is protective of humans and wildlife that consume Delta fish? 3
3. Is the TMDL based on sound science and what kind of scientific review and input has been part of the process? 5
4. What is the basis for the 0.06 ng/L methylmercury water column goal and how is it used? Do dischargers have any assurance that it will not be used in permits to establish effluent limits? 8
5. How does the TMDL take into account the changes methylmercury undergoes in the environment because it is not conservative? Isn't mercury a regional problem rather than a local problem? 9
6. How does the proposed control program address methylmercury in open water and from tributaries, which comprise about 75% of the methylmercury loads? 10
7. Does the Delta mercury control plan address inorganic mercury coming from upstream? Should the emphasis be on upstream sources of mercury first? 12
8. Why exactly are the TMDL allocations for methylmercury rather than total mercury? 14
9. Why are we concerned about wetlands? 16
10. How much will the characterization and control studies cost? 18
11. How will responsible parties know what is expected of them for the characterization and control studies? 21
12. If levels of mercury in fish now are the same as levels measured 30 years ago, why does staff expect that goals of this plan are attainable? 23
13. Are laboratories available to conduct the mercury and methylmercury analysis? 24

1. Is there a mercury problem in the Delta?

Methylmercury concentrations in fish exceed levels recommended for protection of people and wildlife that eat fish. The Delta has been on the Clean Water Act Section 303(d) list of impaired water bodies for many years because fish in the Delta exceeded screening values developed by the U.S. Environmental Protection Agency (USEPA) and the National Academy of Sciences and because the State Office of Environmental Health Hazard Assessment (OEHHA) has issued advisories warning people to limit their consumption of Delta fish due to elevated levels of mercury. For the most recent 303(d) listing cycle, State Board adopted a new listing policy that defined when the State would consider a water body as impaired. Consistent with that policy, the State Board continues to list the Delta as impaired due to elevated levels of mercury in fish.

Concerns about human consumption of Delta fish have existed for many years. In 1971, the State issued an advisory recommending that pregnant women and children not eat striped bass from the Delta and San Francisco Bay. In 1994, the Office of Environmental Health Hazard Assessment (OEHHA) issued an advisory against consumption of sturgeon and continued the warning for striped bass. In 2007, OEHHA released draft safe consumption guidelines covering the Central and South Delta areas for other species of fish. The draft guidelines recommend limited consumption of largemouth bass in the lower San Joaquin River. OEHHA expects to release safe eating guidelines covering other Delta subareas and the lower Sacramento River in 2008.

Concerned about potential effects of mercury on birds, the U.S. Fish and Wildlife Service (USFWS) and the U.S. Geological Survey are evaluating mercury exposure, growth, and fitness in several species of birds that eat fish and other aquatic organisms. Studies have been conducted in the San Francisco Bay area. Concentrations of mercury in blood and eggs in Forster's terns and black-necked stilts in parts of San Francisco Bay are at the levels known to cause sublethal impairments to birds. Although the same types of birds have not been evaluated in the Delta, mercury concentrations in small prey fish in parts of the Delta are significantly higher than concentrations identified by the USFWS as necessary to protect fish-eating birds.

The California Bay-Delta Program also is concerned about mercury in the Delta and has invested $30 million dollars in research on mercury in the Central Valley and Delta. The CalFed Water Quality Program Plan (July 2000) calls for assessment of mercury and methylmercury risks, sources, transport, and transformation and development and implementation of remediation strategies to reduce mercury and methylmercury. The California Environmental Quality Act Findings of Fact contained in the CalFed Record of Decision (ROD Attachment 1, August 28, 2000) state, "*The bioaccumulation of toxic methylmercury in food webs can impact consumers of aquatic organisms, specifically through the consumption of fish caught in the Bay-Delta. This impact is considered significant*."

2. What factors guide the selection of a fish tissue objective that is protective of humans and wildlife that consume Delta fish?

As part of the Delta mercury Basin Plan amendment, staff is proposing a fish tissue objective for Board consideration that is protective of humans and wildlife eating Delta fish as part of the mercury Basin Plan amendment. A tissue objective, which is equivalent to a safe methylmercury level in fish, can be calculated using the equation:

$$\frac{\text{Safe daily MeHg intake * Consumer's body weight}}{\text{Consumption rate}} = \text{Safe MeHg level in fish (i.e., fish tissue objective)}$$

This equation was written for humans, but can be applied to wildlife. In this equation, the "Safe daily MeHg intake" and the "Consumer's body weight" are fixed. The primary variable for Board consideration is the "consumption rate", that is, how many meals a month does the Board think people should be able to safely consume in an unimpaired estuary.

The "Safe daily MeHg intake" is also called a reference dose (RfD). At or below the RfD for methylmercury, fish consumers are expected to be free from harmful effects of methylmercury. RfDs were developed by the USEPA for humans and by the USFWS for birds and mammalian wildlife. We have no scientific basis for changing the RfD values that were developed by federal agencies. The assumed consumer's body weight for humans is 70 kg; wildlife body weights are species-specific.

As was mentioned above, the main consideration for the Board in determining a fish tissue objective to protect humans is to determine what consumption rate is appropriate (i.e., how many meals per month of Delta fish should people be able to safely eat). Staff calculated fish mercury levels to protect humans and various fish-eating wildlife species and developed alternatives for the Board to consider. Objectives to protect human health vary depending upon what consumption rate is used. Fully protecting people who eat more fish will result in a lower fish tissue objective and a more restrictive and expensive control program.

Staff evaluated four possible methylmercury fish tissue objectives to protect humans (Table A). Each alternative allows for a different consumption rate and/or type of fish to be consumed. Commonly consumed trophic level (TL) 2 organisms in the Delta are mostly clams, TL3 fish include salmon, bluegill, and sturgeon, and TL4 fish include bass, crappie, and catfish.

The 0.58 mg/kg option uses the USEPA default consumption rate. This consumption rate was established in a 1994-96 nationwide food survey. The USEPA is not likely to approve a higher human health objective than this. In addition, the objective is greater than that recommended by the USFWS as protective of bald eagles (see discussion below). Advocacy groups representing subsistence-fishing communities recommend the 0.05 mg/kg objective.

Table A: Possible TL4 Fish Tissue Objectives for Board Consideration.

Mercury Objective in Large TL4 Fish (mg/kg)	**Meals per Month** (assumes one meal is 240 grams)	**Distribution of Delta Fish Consumed**
0.58	2	Mix of fish: 22% TL2, 46% TL3, & 32% TL4
0.29	2	100% TL4
0.24	4	50% TL3 & 50% TL4
0.05	16	100% TL4

Staff recommends a fish tissue objective for large TL4 fish of 0.24 mg/kg, which corresponds to a consumption rate of 32 g/day or four meals a month of a mix of TL3 and TL4 fish. It is important to note that there has been no comprehensive study of human fish consumption rates in the Delta. In contrast, a fish consumption study was conducted in 1998-1999 in San Francisco Bay. The study showed that 95% of people that consumed Bay fish ate four meals/month or less. The San Francisco Bay Water Board used this consumption rate as the basis for its tissue objective of 0.2 mg/kg mercury, to be measured in the five Bay fish species most commonly caught and eaten.

In addition to the human health alternatives, staff calculated safe fish tissue levels for wildlife species that eat fish and other aquatic organisms in the Delta. Consideration of wildlife risk is important because the fish tissue objectives must fully protect threatened and endangered species. Staff's recommended objective fully protects listed wildlife in the Delta. Sensitive Delta species that are designated as threatened or endangered include the California Least tern (federal list) and bald eagle (State list). The safe methylmercury concentration in large TL4 fish for bald eagles is 0.31 mg/kg (comparable to 0.24 mg/kg in Table A). For the California Least tern and other wildlife that eat small fish, staff's recommended alternative includes a safe fish tissue level in small fish (0.03 mg/kg) that was confirmed by the USFWS as protective.

In summary staff recommends a consumption rate that would protect people eating four meals a month of a mixture of the most popular fish in the Delta (catfish, bass, salmon, carp and bluegill). The recommended objective would also protect the most sensitive wildlife species in the Delta.

3. Is the TMDL based on sound science and what kind of scientific review and input has been part of the process?

The Delta methylmercury TMDL has been scientifically reviewed by two independent scientists through the State Water Board's formal peer review program (as required by the Porter Cologne Act) and by a mercury expert retained by the Delta Protection Commission. A statistician at UC Davis reviewed the calculations of total mercury and suspended sediment loads entering and leaving the Delta. In addition, data used in the Delta TMDL and the logic behind the water-fish linkage analysis were subject to detailed scientific review by a panel of mercury experts through the CalFed Program. None of the peer review scientists attended the March 2007 workshop, but numerous stakeholders presented information on various aspects of the peer review comments. Many of the stakeholder comments focused narrowly on certain parts of the peer reviews and used this to conclude that the peer reviewers did not believe that the proposed TMDL was based on sound science. The following paragraphs explain why this conclusion is not accurate.

Dr. David Sedlak and Dr. Alex Horne, both Professors at UC Berkeley, provided independent peer review comments through the Water Board peer review program. Dr. Sedlak researches mercury chemistry and factors affecting methylmercury levels. Dr. Horne studies the measurement and treatment of pollutants, including mercury, in water. They received the June 2006 draft Basin Plan amendment staff report and Delta TMDL report with supporting data. They were specifically asked to review the linkage between methylmercury in water and fish, the mercury load calculations, and the potential effectiveness of the proposed control program in reducing mercury in fish. In addition, they were asked to comment on any other scientific issues of concern and whether the proposed regulations are based on sound scientific knowledge, methods, and practices. Although specifics of the Basin Plan amendment have changed since the June 2006 draft, the scientific basis of the proposed amendment has not changed.

At the start of his response, Dr. Sedlak stated, "*Given the complexity of the problem and the difficulties associated with setting goals that are achievable, I believe that the staff members have used the available scientific data in a reasonable matter. Although I have some concerns about specific details, I have not found any major flaws that would call the scientific approach into question*." About the proposed characterization and control studies and phased approach to meeting methylmercury allocations, he wrote, "*I believe that the staff has employed a sound approach to implementing the TMDL in a stepwise fashion that is consistent with the principles of adaptive management*".

Dr. Horne did not criticize the scientific basis of the linkage analysis, the evaluation of sources and loads of mercury and methylmercury, or the basis of the proposed control program that reducing methylmercury in water and sediment will reduce methylmercury levels in fish. Dr. Horne had several specific comments about the TMDL, but his main concern was that the implementation of a control program would threaten Delta wetland restoration efforts.

Dr. Horne raised five concerns:

1) The TMDL's "single-minded pursuit of mercury control threatens Delta restoration" and would not allow the full recovery of wildlife species.
2) "Arbitrary decisions" by staff about what mercury and methylmercury can and cannot be controlled. (Dr. Horne's example is that the TMDL report mentions sulfate as a potentially controllable factor affecting methylation but not iron and redox.)
3) The lack of available offset projects needed to offset the large amounts of methylmercury produced by wetlands predicted to be restored in the Delta.
4) "Unethical scientific practices" of staff and the USFWS, which recommended the wildlife targets, in selecting the most conservative value of some analyses and "cherry-picking" data.
5) "Fossilized standards", in that water quality standards and Basin Plan requirements are typically hard to change when new information becomes available.

In response to Dr. Horne's comments, staff revised the proposed Basin Plan amendment language to strengthen the commitment of the Regional Water Board to review the program after the Phase 1 studies are completed and adjust requirements, including methylmercury allocations to wetlands, if necessary. In addition, staff added language to the proposed amendment that outlines guidance for a pilot offset program in Phase 1 of Delta mercury control program and language indicating that for Phase 2 a long-term offset program will be developed along with the State Water Board's offset policy. This will allow more time to develop information useful for the Phase 2 offset program and to identify offset projects.

Dr. Horne suggested a trading program that exchanges methylmercury production for wetland restoration benefits. Such an exchange program between environmental benefits does not directly address the methylmercury impairment. Staff agrees with Dr. Horne, though, that habitat benefits of wetlands and methylmercury production should be carefully considered. The CalFed Record of Decision identified methylmercury production as a potentially significant impact of wetland restoration in the Delta and states that mitigation may be needed.

Staff also reconsidered its methods in each of Dr. Horne's examples of poor scientific practice and arbitrary decisions. Dr. Horne questioned the derivation of safe levels of fish methylmercury needed to protect wildlife, which appeared to him to drive the water quality objectives and control program goals. Staff explained in the response to scientific peer review comments (Appendix F of the February 2008 BPA staff report) that the wildlife safe levels are less stringent than those needed to protect humans eating one meal per week of Delta fish and that human consumption rates determine the goals used to determine methylmercury source reductions.

Dr. Tom Grieb of Tetra Tech, Inc., was asked by the Delta Protection Commission to review the TMDL and proposed control program. Dr. Grieb cited data from Florida that support the understanding that wetlands can be significant sources of methylmercury. Studies elsewhere have shown ways to influence methylation in wetlands. He pointed out that the variations in types of wetlands and land uses in the Delta require more study to better estimate loads and control options. He noted in his comments that his “concerns point to the importance of the Characterization and Control Studies that are a requirement of the TMDL.”

Dr. Grieb highlighted uncertainties and sources of variation in the water to fish methylmercury linkage relationship. In the TMDL Report, methylmercury fish and water data from five subareas are plotted (Figure 5.2). An equation describing the best-fit line between all of these points (regression) is used to calculate a single aqueous methylmercury goal for the entire Delta. Dr. Grieb suggested an alternative approach, in which the fish and water data are used to develop five slightly different linkages in the subareas. Staff recognized in the June 2006 TMDL report that this alternative approach could be used, and found that it produces aqueous methylmercury goals for the Mokelumne, Sacramento, and San Joaquin River subareas that are lower (more stringent) than staff’s proposed aqueous methylmercury goal of 0.06 ng/L. Staff did not recommend the approach because we do not believe it is as statistically robust as the regression-based approach.

Dr. Grieb expects that the Delta mercury control program will increase costs or otherwise inhibit wetland restoration or flood management projects because of the requirements to participate in methylmercury characterization and control studies, monitor and meet discharge criteria for total and methylmercury by management practices or offsets. Staff agrees that although staff is seeking funding options, landowners and managers may need to contribute funds for characterization and control studies. Revisions to the proposed Basin Plan amendment have clarified other concerns. Allocations are only for methylmercury; therefore, wetlands – which are not expected to act as sources of total (inorganic) mercury – are not required to comply with any discharge criteria for total mercury. Achievement of the methylmercury allocations is not required until 2030, about 15 years after the Regional Water Board would reevaluate the program at the end of Phase 1. Staff addressed Dr. Grieb’s concerns about dredging through discussions with dredging interests and revisions to the proposed Basin Plan amendment.

The California Bay-Delta Authority (CBDA) funded much of the data collection and analysis used in the development of the TMDL. This included data collection for source estimates and the mass balance for methyl and total mercury. The CBDA also funded a study of mercury concentrations in Delta fish. The data collection and analysis followed a thorough Quality Assurance Project Plan that has since been used by other mercury programs. During its seven year duration (2000 to 2007), independent, internationally recognized mercury experts regularly reviewed the program including study design, data analysis and conclusions. The CBDA’s Mercury Science Review Team did not explicitly comment on the TMDL and Delta mercury control program.

4. What is the basis for the 0.06 ng/L methylmercury water column goal and how is it used? Do dischargers have any assurance that it will not be used in permits to establish effluent limits?

Staff is recommending that the Regional Water Board adopt methylmercury fish tissue objectives for the Delta. CalFed's mercury experts concluded: "The problem with mercury in the Delta's aquatic ecosystems can be defined as biotic exposure to methylmercury." Several local and nationwide studies have found statistically significant positive correlations between annual average methylmercury concentrations in water and in aquatic organisms. The local studies show that water methylmercury concentrations explain almost all (91%) of the variation in bass body burden.

Staff's proposed tissue objective of 0.24 mg/kg methylmercury in large TL4 fish correlates to an unfiltered water column methylmercury concentration of 0.066 ng/L. Staff recommends that 0.060 ng/L methylmercury in unfiltered water be used as the ambient water goal for the Delta and Yolo Bypass. This proposed ambient water goal incorporates an explicit margin of safety of about 10%. The water column goal effectively describes the assimilative capacity of Delta waterways.

The USEPA requires that, in a TMDL, there be a clear linkage between the fish tissue objective and the load reductions that are required to meet it. The water column goal is the best estimate of the methylmercury concentration in ambient Delta water that must be met to reach the fish tissue objectives (including a small margin of safety). There is no direct correlation between total mercury and fish tissue. The methylmercury goal for ambient water is essential because, without it, there is no reasonable way to determine the load reductions that are needed from point and nonpoint sources. In addition, monitoring methylmercury in water is an efficient means of assessing program progress and is a good surrogate for evaluating potential improvements in fish tissue concentrations. Staff is not recommending that the methylmercury goal be established as a water quality objective.

The proposed Basin Plan amendment does not establish the methylmercury goal as an effluent limit. The proposed Basin Plan amendment now states:

> "The ambient water methylmercury goal of 0.06 ng/l is used to determine the following: reductions required from existing methylmercury inputs to the Delta to achieve the fish tissue objectives; responsible parties required to conduct Phase 1 Characterization and Control Studies; and Phase 1 effluent methylmercury concentration limits for existing facilities that discharge effluent with annual average methylmercury concentrations less than 0.06 ng/l. From [the effective date of this amendment] through [eight years after the effective date of this amendment], the 0.06 ng/l goal will not be used as an effluent limit for discharges with annual average methylmercury effluent concentrations greater than 0.06 ng/l. After [eight years after the effective date of this amendment] the Regional Water Board will reevaluate the 0.06 ng/l methylmercury goal and determine at that time which, if any, effluent limit adjustments are necessary. After [eight years after the effective date of this amendment], the methylmercury goal of 0.06 ng/l will not be established as an effluent limit in permits unless the Regional Water Board makes that determination and amends the Basin Plan."

5. How does the TMDL take into account the changes methylmercury undergoes in the environment because it is not conservative? Isn't mercury a regional problem rather than a local problem?

Staff recognizes that the aqueous concentration of methylmercury at any site or time is the result of the interaction of several factors, including local methylmercury production and degradation and inputs from upstream. Regional Water Board staff and others have collected data for waterways in which processes of methylmercury production and accumulation downstream are dominant and other waterways in which net removal is the dominant process. Clearly, methylmercury is not always acting in a conservative fashion.

The proposed Basin Plan amendment divides the Delta into subareas based on the hydrologic characteristics and mixing of source waters. A network of methylmercury measurements on the major tributaries as they entered the Delta and at locations within the Delta show how average methylmercury concentrations change as water moves across the system. The allocations for methylmercury sources in each subarea are based on conditions observed in each subarea from actual in-stream measurements and so incorporate non-conservative changes in methylmercury concentrations. It is reasonable to assume that reducing loads of methylmercury to any subarea will result in lower concentrations of methylmercury in water and biota in that area. There is no information that suggests that methylmercury discharged into a water body would disappear so rapidly that none of it would be incorporated, at least in part, into the food chain.

Mercury is a regional problem because fish methylmercury levels throughout the Delta, the Yolo Bypass, and many of the tributary waterways are higher than is considered safe for human and wildlife consumption. This is because inorganic mercury and methylmercury sources are present throughout much of the region. However, fixing the problem will take local, waterway-specific solutions because each waterway has its own unique set of methylmercury and inorganic mercury sources. As noted earlier, staff developed a separate methylmercury allocation scheme for each hydrologic subarea because the levels of impairment within and the methylmercury sources that discharge to each subarea are different. For example, to reduce fish methylmercury levels in the Sacramento subarea of the Delta, the inorganic mercury and methylmercury from sources within the Sacramento subarea and its tributary inputs (e.g., the Sacramento River and Morrison Creek) must be reduced. Reducing inputs from the Cache Creek Settling Basin, which drains to the Yolo Bypass subarea, will not result in fish methylmercury reductions in the Sacramento River at River Mile 44 because, except during the most extreme tidal fluctuations, the Sacramento River at River Mile 44 is not downstream of the Yolo Bypass.

6. How does the proposed control program address methylmercury in open water and from tributaries, which comprise about 75% of the methylmercury loads?

Methylmercury in the Delta comes from within-Delta sources such as sediments in wetlands and open-water channels, agricultural areas, wastewater and urban runoff conveyance systems, and atmospheric deposition, as well as from tributary inputs. Methylmercury loading in the tributary inputs comes from a similar mix of sources and from legacy mining activities. Methylmercury from open-water sediments within the Delta and Yolo Bypass account for about 17% of methylmercury loading to the Delta. Tributary inputs account for about 58% of methylmercury loading to the Delta.

Reductions in methylmercury loading to all of the Delta subareas – except the Central and West Delta – need to take place to achieve the proposed fish tissue objectives throughout the Delta. Staff's evaluation of the sources that contribute methylmercury to each Delta subarea indicates that fish tissue objectives cannot be achieved in the Yolo Bypass and Marsh Creek subareas if methylmercury loading from open-water sediments is not reduced. Thus, staff recommends that methylmercury allocations for open water sediments in the Sacramento, San Joaquin, Mokelumne/Cosumnes, Central Delta, and West Delta subareas be capped at existing levels, while those for the Yolo Bypass and Marsh Creek subareas incorporate reductions. These recommendations are reflected in the open water allocations described by Table F in the proposed Basin Plan amendment.

In general, methylmercury production in open water sediments can be reduced by two methods: (1) reduce the amount of inorganic mercury available in the sediment to be converted to methylmercury and (2) control activities that enhance the production of methylmercury in the Delta and its upstream tributary watersheds.

Methylmercury inputs from open water sediments throughout the Delta and Yolo Bypass and from tributary inputs are expected to decrease as inorganic mercury control efforts take place in the tributary watersheds. The Basin Plan amendment requires a reduction in the loads of inorganic mercury exported from the Cache Creek Settling Basin to be implemented within seven years after the effective date of the amendment. Reducing the Settling Basin mercury discharges to the Yolo Bypass is expected to result in rapid reductions in methylmercury production by open water sediment in the Yolo Bypass. In addition, staff recommends that additional inorganic mercury control actions focus on sources in the Marsh Creek watershed, as well as the Feather River, American River and Putah Creek watersheds, which, along with Cache Creek, discharge the most mercury-contaminated sediment to the Delta.

Other activities such as water diversion and storage, dredging, and flood conveyance projects can affect methylmercury production in open channel sediments. Because of the complexity of water management activities and their operational constraints, staff does not recommend any modification to current water management activities. Instead, staff recommends that proponents for new Delta salinity controls and other water management projects that have the potential to increase methylmercury production in the open channels in the Delta and Yolo Bypass conduct methylmercury characterization and control studies. These studies would determine baseline conditions, evaluate potential negative impacts of project alternatives on ambient methylmercury levels, and develop methylmercury reduction measures for alternatives that would increase ambient methylmercury levels. In other words, staff recommends that new project proponents evaluate their alternatives and either select the alternative that does not result in methylmercury increases, or offset any unavoidable methylmercury increase.

More information is needed to determine how to effectively reduce methylmercury loading in the tributary inputs. Tributary-specific methylmercury and inorganic mercury sources analyses will take place during the next several years. Staff expects that the tributary sources of methylmercury will be a similar mix of the same sources that were found in the Delta (i.e., NPDES, wetlands, stormwater, and in-channel production, with much of the methylmercury loading coming from wetlands and in-channel production). Sources of inorganic mercury in the tributaries also include discharges from mines and erosion from mercury-contaminated stream banks. Operation of dams and other water management and flood control activities likely influence inorganic mercury loading and methylmercury production in the tributary watersheds. Even with aggressive cleanup of mine sites and other mercury sources in the tributary watersheds, it may take generations to decrease mercury loading to the Delta to a point where Delta fish tissue objectives are met. Because so much mercury is already deposited in the streambeds and banks, natural erosional processes will need to be factored into the long-term mercury control strategy. The 2006 303(d) List for California includes 38 mercury-impaired water bodies located in the Delta's tributary watersheds, including Marsh Creek and Marsh Creek Reservoir, Sacramento River, San Joaquin River, Putah Creek, American River, Feather River, Clear Lake, Cache Creek and numerous other creeks and reservoirs located throughout the Coast Range and Sierra Nevada mountains. Five TMDLs have been completed for the Clear Lake/Cache Creek watershed and future TMDLs are planned for the remaining watersheds. Site-specific point and nonpoint source load reductions will be assigned as Basin Plan amendments are developed for each of these watersheds.

Additional information about reducing inorganic mercury from upstream sources is provided in the response to question #7.

7. Does the Delta mercury control plan address inorganic mercury coming from upstream? Should the emphasis be on upstream sources of mercury first?

The Delta mercury control plan concurrently addresses both inorganic mercury coming from upstream and methylmercury sources in and upstream of the Delta. A key component of reducing watershed sources of inorganic mercury is reducing legacy-mining sources. There are more than 8,000 gold and mercury mine sites in the Delta's tributary watersheds, and about 80% of the sites occur upstream of major dams. The proposed amendment requires short-term mercury reduction efforts on the Cache Creek Settling Basin. The Cache Creek watershed is the most significant source of mercury to the Yolo Bypass, where there are large wetland areas and expansive restoration projects planned for the next two decades. The proposed amendment requires improvements in the trapping efficiency and establishment of a maintenance program for the Cache Creek Settling Basin to limit legacy mercury loading from Cache Creek.

In addition, State and federal agencies have already incurred about $11 million to characterize and implement cleanup actions at 13 mercury and gold mining sites in the Delta's tributary watersheds, and estimated that it would cost another $113 million to begin or continue cleanup at 31 high priority sites in the Central Valley. Staff also has contracted an environmental engineering consultant to identify and evaluate additional legacy mercury reduction projects in the Delta's tributary watersheds, such as improving existing settling basins and building new ones. Given the number of sites that must be remediated and the high cost of mine cleanups and sediment trapping basins, staff expects that the budget to address legacy mercury in the Delta's tributary watersheds could easily increase tenfold during the next three decades. However, even with aggressive cleanup of mine sites, it may take generations to decrease inorganic mercury loading to the Delta to a point where measurable improvements in fish mercury levels are achieved. Because so much mercury is already deposited in the streambeds and banks, any control program may need to rely on natural erosion to remove most of the mercury that has already left the mine sites. To more quickly achieve the fish tissue objectives in the Delta, additional remediation efforts need to focus on legacy sources downstream of major dams. Near-term efforts should focus on the watersheds that (1) discharge the most mercury-contaminated sediment to the Delta (Cache Creek, Feather River, American River, and Putah Creek); and (2) discharge to areas of the Delta where reductions in open-water methylmercury production are needed to comply with the proposed allocations (Yolo Bypass and Marsh Creek).

To further shorten the time it takes to observe decreases in Delta fish mercury levels, staff recommends that concurrent efforts take place to reduce direct discharges of methylmercury and activities that enhance the production of methylmercury in the Delta and its upstream tributaries. This is in keeping with State Board's directive in a 2005 resolution that states, "The State Water Board finds that mercury pollution poses a serious long-term threat to public health and the environment, and therefore finds that time is of the essence in developing an appropriate plan to restore these waters of the State." About 300,000 licensed sport and subsistence anglers fish in the Delta each year, along with an unknown number of unlicensed anglers. People from multiple ethnicities, communities, and income levels regularly eat Delta fish for reasons that include need, culture, and enjoyment. Available information indicates that some populations consume large quantities of Delta fish. In addition, mercury levels in fish consumed by wildlife species such as the Least tern and Belted kingfisher exceed established safe levels. Recent studies show that fish mercury levels in some areas of the Delta and Yolo Bypass are equal to concentrations that have measurably harmed fish-eating birds elsewhere in the United States.

It makes sense for the methylmercury and inorganic mercury control actions to take place concurrently. Methylmercury management efforts, along with high-priority inorganic mercury control actions such as improving the Cache Creek Settling Basin, will result in more immediate improvements in the local Delta area. Legacy mercury control actions that take place further upstream will result in more widespread improvements (e.g., in the creeks downstream of a mine cleanups, as well as in the Delta and downstream San Francisco Bay), but it may take generations before downstream improvements associated with mine cleanups are observed.

Staff developed a Delta control program before upstream programs because at the time when the Central Valley Water Board's TMDL priorities were established, more information was available for the Delta than any of its tributary watersheds. Thirty-eight water bodies located in the Delta's tributary watersheds are 303(d)-listed as impaired by mercury; to date, five TMDLs have been completed in the Clear Lake/Cache Creek watershed. The USEPA has instructed States "to use the data that are available" to develop TMDL control programs, and has placed great pressure on States to develop the TMDLs as quickly as possible. It makes scientific and legal sense to begin with waterways that have more data available than others, in anticipation that more information will become available for the data-scarce water bodies. Such has been true of Central Valley waterways. Several recent CalFed-funded projects will provide new fish and water methylmercury data for the American, Feather, Sacramento, and San Joaquin Rivers watersheds downstream of major dams. These data sets will provide a good foundation for TMDLs for nine of the 33 water bodies in the Delta's tributary watersheds that are currently on the 303(d) List, and provide additional guidance for upstream methylmercury and inorganic mercury reduction priorities.

The proposed Basin Plan amendment includes allocations for methylmercury sources within the Delta and Yolo Bypass that must be met by 2030. Achieving these allocations will address about 30% of the total methylmercury load reduction required to address the fish impairment in the Delta. The rest of the required methylmercury load reductions will come from methylmercury and total mercury control actions that will be implemented in the upstream watersheds. Upstream control programs are scheduled for development and implementation before the 2030 deadline. The upstream programs will be able to take advantage of, and build upon, the methylmercury management practices developed during Phase 1 of the Delta program. In addition, the Delta and upstream control programs will continue to identify high priority legacy mercury reduction projects. It is anticipated that this combination of actions can achieve the fish tissue objectives throughout the Delta.

8. Why exactly are the TMDL allocations for methylmercury rather than total mercury?

Over 95% of the mercury in fish is methylmercury. CALFED research has demonstrated a positive correlation between methylmercury concentrations in water and in fish tissue in the Delta. Higher water concentrations result in higher tissue levels. Darell Slotton (UC Davis) and Tom Grieb (Tetra Tech, Inc.) observed similar relationships in the Cache Creek and Guadalupe River watersheds, as have other researchers elsewhere in the nation.

This indicates that methylmercury concentrations in water are one of the primary factors determining methylmercury concentrations in fish. Further, the R^2 for the correlation between methylmercury concentrations in Delta fish and water was 0.91, indicating that water concentrations explained most (>90%) of the variation in fish mercury body burden. We agree that other factors may also influence tissue concentrations; the R^2 indicates that other factors may account for about 9% of the variation in the Delta. There are several papers in the peer-reviewed literature that show no correlation between total mercury in water and methylmercury levels in fish.

Therefore, reducing methylmercury concentrations in ambient water is expected to reduce tissue levels. To reduce the amount of methylmercury in ambient water, the sources of methylmercury to that water need to be reduced. Hence, the Delta TMDL has allocations for point (NPDES facility and MS4 discharges) and nonpoint (wetlands, agriculture, atmospheric deposition) sources of methylmercury that discharge directly to the Delta, as well as for tributary inputs.

The Delta TMDL does not have allocations for sources that discharge inorganic (total) mercury directly to the Delta because it is not knowable whether that inorganic mercury will be methylated and made bioavailable immediately downstream of the discharge, 100 miles downstream in San Francisco Bay, or even never methylated if it is buried in a sediment deposit. A discharger could decrease its total mercury discharge, but, if there was not a sufficient methylmercury discharge decrease associated with the total mercury decrease, the discharger’s efforts may not adequately address its contribution to the receiving water impairment at its discharge point. However, a methylmercury discharge is immediately available for biotic uptake in the receiving water. If a discharger decreases its methylmercury discharge, it will immediately and directly address its contribution to the receiving water impairment.

In general, individual methylmercury sources can be reduced by two methods: (1) control activities that enhance the production and/or degradation of methylmercury and (2) reduce the amount of inorganic mercury available to be converted to methylmercury. A discharger may have the option to reduce its methylmercury discharge by implementing on-site control actions to (a) reduce mercury methylation at its site, (b) increase de-methylation at its site, and/or (c) decrease the supply of inorganic mercury that gets methylated. The implementation method does not matter, so long as the methylmercury discharge is reduced (and, of course, inorganic mercury and other pollutant discharges are not increased).

As noted in responses to previous questions (#6 and #7), addressing inorganic mercury – particularly legacy mercury sources – is an important component of the proposed Delta control program. The proposed program focuses inorganic mercury reduction efforts on upstream legacy sources (e.g., improving Cache Creek Settling Basin trapping efficiency) to enable long-term decreases in wetland and open-water methylmercury production in the Delta, and methylmercury management actions to address near-term reductions in direct methylmercury discharges to the Delta.

Regardless of how successful inorganic mercury reduction projects are, there still will be a need to manage methylmercury discharges. Naturally-occurring mercury in soil and global atmospheric sources are high enough that we will need to carefully evaluate activities in the watershed that can increase methylmercury discharges or otherwise enhance mercury methylation. Methylmercury discharges are expected to increase substantially due to wetland restoration and population growth in the Delta and its tributary watersheds if methylmercury management is not part of the Delta control program.

9. Why are we concerned about wetlands?

Wetlands provide many benefits to the environment, including wildlife habitat and removal of pollutants from water bodies. There are extensive efforts by federal, State and local agencies, and many private groups, to increase the wetland acreage in California. Why has staff proposed monitoring and regulation of wetlands that MIGHT ultimately hamper wetlands development? As explained above, it is very clear that biologic activity can methylate inorganic mercury, and that essentially all the mercury in humans and wildlife is methylmercury. Unfortunately, monitoring has demonstrated that some wetlands are very efficient at forming methylmercury, which then threatens wildlife in the wetland as well as humans and wildlife that consume fish from waterways that receive wetland drainage.

Even though much of the research has found that wetlands act as sources of methylmercury, recent data collected in the Delta region indicate that some wetlands may have little net methylmercury production or even act as sinks for methylmercury. That is, in some wetlands, more methylmercury comes in than goes out. Wetlands that act as methylmercury sinks are not a concern for the Delta control program. More research is needed to understand the processes that affect a wetland's methylmercury production and degradation so that wetland restoration can occur with minimal methylmercury production increases.

Studies **are underway** to understand how different wetland types and water and vegetation management practices affect the production of methylmercury. At this time, it appears that seasonally flooded wetlands tend to be areas of high methylmercury production, while permanently flooded wetlands actually may have little net methylmercury production or act as methylmercury sinks. It may be possible to construct types of wetlands that do not methylate mercury as efficiently. Also, it may be possible to re-plumb the wetlands so that drainage from wetlands producing methylmercury will drain into other wetlands that tend to reduce methylmercury or use the wetland drainage for other uses such as irrigated agriculture.

Whether solutions can be found that will allow continued wetlands development without increasing the production of and exposure to methylmercury is not known at this time. However, no load reduction requirements on existing or proposed wetlands will go into effect upon the adoption of the Delta control program. No load allocations for wetlands or any other methylmercury sources will go into effect for at least seven years after the adoption of the Delta control program, by which time studies should have clarified many current questions, and the Regional Water Board will have reevaluated the Delta control program based upon the new data.

What happens if ultimately production of methylmercury in wetlands cannot be controlled and still maintain the habitat function and other environmental benefits of the wetlands? If studies do not identify feasible ways of controlling methylmercury production in wetlands, the Board will have some very hard decisions to make in the future review of the Delta control program. Without information from the studies, the Board will have even a more difficult decision.

The Board could determine that the benefits of the wetlands outweigh the problems caused by the methylmercury production, and determine that wetlands should continue to be constructed and operated without consideration of methylmercury production. Wetlands are, however, a major producer of methylmercury in the Delta. There are more than 26,000 acres of permanent and seasonal wetlands in the Delta and Yolo Bypass. CalFed intends to increase wetland acreage in the Delta and Yolo Bypass by 75,000 to 90,000 acres, which represents about a three to four times increase in wetland acreage from current conditions. If production of methylmercury from wetlands is not addressed, either greater reductions in methylmercury from other sources (sewage treatment plants, municipal stormwater systems, etc.) will have to be required, or the desired fish tissue concentration reductions will not be achieved, causing fish and wildlife to be at greater risk from consuming Delta fish.

Alternatively, the Board could determine that some reduction in methylmercury from wetlands should be required. This could result in restrictions on the types of wetlands constructed, changes in operations of new or existing wetlands, or prohibition of wetlands construction in areas with particularly high sediment mercury levels.

Current studies provide hope that wetlands can be constructed and managed to reduce methylmercury production, but additional studies are needed before this can be confirmed and appropriate technical standards developed. The proposed Delta control program requires studies of wetlands and all sources of methylmercury over the next few years, so that additional information will be available for Board review of the entire program before any load reduction requirements or other restrictions go into effect.

10. How much will the characterization and control studies cost?

Staff estimates indicate that the potential cost of the proposed studies is not a trivial amount. Dischargers may develop individual studies, but staff is encouraging dischargers of similar sources to work together to conduct collaborative studies to minimize costs and maximize effectiveness. Staff developed a range of study cost estimates for each source type assuming that collaborative studies take place (Table B). Detailed supporting information for these cost estimates is provided in Appendix C of the February 2008 Basin Plan amendment draft staff report. Staff has begun working with dischargers and State and federal agencies to identify potential funding sources for the proposed methylmercury characterization and control studies and is committed to continuing such efforts.

Table B: Summary of Estimated Study Costs.

Source	Cost (Low)	Cost (High)
Studies for Existing Methylmercury Sources		
Cache Creek Settling Basin	$120,000	$330,000
NPDES Facilities	$500,000	$1.3 million
NPDES MS4s	$120,000	$1.1 million
Wetlands	$730,000	$2.8 million
Agriculture	$430,000	$820,000
Air Emissions & Atmospheric Deposition	$1.5 million	$3.0 million
Studies for Potential New Projects		
Flood Conveyance	$570,000	$770,000
Water Management	$420,000	$640,000
Tributary Studies		
Methylmercury & Inorganic Mercury Source Analyses for Non-303(d) Listed Watersheds	$465,000	$465,000
Legacy Mercury Control Feasibility Studies	$250,000	$500,000
Study Oversight		
Technical Advisory Committee, Fact Sheet Development & Study Coordination	$300,000	$500,000

Because more information is currently available for some methylmercury sources than others, and because the complexity of the different sources varies substantially, study costs vary by source type. For example, the wetland source category is the most complex, yet, compared to all other sources except atmospheric deposition, the least amount of data are available for Delta wetlands. There are more than 26,000 acres of permanent and seasonal wetlands in the Delta and Yolo Bypass. CalFed intends to increase wetland acreage in the Delta and Yolo Bypass by 75,000 to 90,000 acres, which represents about a three to four times increase in wetland acreage from current conditions. Existing and proposed Delta wetlands vary substantially by characteristics such as flooding duration, depth, timing, water residence time, tidal influence, vegetation, source water, soil substrate characteristics, and sediment mercury concentrations. A collaborative methylmercury characterization study should evaluate seasonal methylmercury production and degradation within the variety of Delta wetland types. The follow-up methylmercury control study should focus on those wetland settings that have the greatest methylmercury input to Delta and Yolo Bypass waterways.

Phase 1 wetland characterization and control studies should augment wetland studies that are in progress. At the time the Delta TMDL was developed, information from only one wetland study was available. As shown in Table C, studies are underway at three additional sites in the Delta and several sites in its tributary watersheds. However, only the Yolo Bypass study is evaluating potential methylmercury management practices.

Table C: Current Wetland Study Sites in the Delta Region.

Watershed	Site	Marsh Type
Delta	Twitchell Island	2 Permanent (test ponds)
	Browns Island	Permanent, tidal
	Sycamore Slough	Permanent, tidal
	Yolo Bypass	Permanent & seasonal
Cache Creek	Anderson Marsh	Permanent
	Cache Creek Nature Preserve	Permanent
Mud Slough (San Joaquin Watershed)	San Luis National Wildlife Refuge	2 Permanent, 6 Seasonal
Suisun Marsh (Suisun/San Francisco Bay)	First Mallard Branch (interior marsh)	Permanent, tidal
	Suisun Slough (mouth)	Permanent, tidal

In contrast to wetlands, the municipal wastewater source category has the most available information. Effluent methylmercury concentration data are available for 64 municipal wastewater treatment plants (WWTPs) in the Delta and its tributary watersheds downstream of major dams; influent data are available for 23 WWTPs. In addition, the Sacramento Regional County Sanitation District WWTP in the Central Valley Region and the San Jose/Santa Clara WWTP in the San Francisco Bay Region have conducted detailed inorganic mercury and methylmercury fate and transport studies that evaluated potential mercury removal pathways. A collaborative study should build on the available data by incorporating a detailed analysis of the treatment processes in place at the other Central Valley WWTPs when their effluent data were collected. The results of the analysis would direct additional characterization and control studies at WWTPs representative of different suites of treatment processes associated with high and low effluent methylmercury concentrations.

Although methylmercury and total mercury inputs from atmospheric wet deposition comprise a small percentage of direct loading to the Delta, their input to the watershed loads could be much more substantial. The proposed amendment includes the recommendation that the USEPA, State Water Board, and Air Resources Board develop a memorandum of understanding to conduct studies to evaluate local and statewide mercury air emissions and deposition patterns and to develop options for a load reduction program(s). These studies are likely to be by far the most expensive of all source-specific study costs that staff evaluated.

The Basin Plan amendment also proposes that the Regional Water Board organize a technical advisory committee (TAC) to oversee, design and review conclusions of the characterization and control studies, analogous to the external scientific review committees established for CalFed's mercury program. See the response to Question 9 for more information about the role of a TAC. The use of a TAC will help ensure that study funds are spent effectively.

11. How will responsible parties know what is expected of them for the characterization and control studies?

The proposed Basin Plan amendment provides a general description of study requirements and goals. The amendment establishes a process to define study details and review study results. The process includes formation of a technical advisory committee (TAC) to assist in the development of the mercury characterization and control studies and evaluate study results. Dischargers will be responsible for submitting study workplans for Executive Officer approval. The TAC will review the workplans and study results and make recommendations to dischargers and staff.

The proposed amendment outlines the minimum requirements for the characterization and control studies and defines which source categories are responsible for the studies. Specific point sources (e.g., WWTPs and urban stormwater management agencies) responsible for the studies are identified by name and NPDES permit number in the proposed amendment language. However, the draft amendment language does not identify individual landowners or responsible agencies for nonpoint sources such as irrigated agriculture and managed wetlands. Therefore, working with the Water Quality Coalitions established under the Irrigated Land Regulatory Program will be the primary mechanism for implementing studies for irrigated agriculture and wetlands.

After the amendment is approved, staff will notify dischargers and other responsible parties of the Delta mercury control program requirements and the process for developing and completing studies and evaluating their conclusions. Staff is currently developing a methylmercury characterization and control study “fact sheet” for each source category that could be released in draft form once the Central Valley Water Board approves the Basin Plan amendment. The fact sheets would re-state the minimum study requirements and deadlines outlined in the Basin Plan amendment and describe which existing and new sources would be required to conduct the studies. The fact sheets would provide general guidance on how to develop a collaborative study for each source category that would effectively produce the data needed to determine feasible methylmercury control measures, their costs, and potential time schedules for implementation.

The fact sheets would provide general guidance for the studies. The TAC would oversee study design and evaluate results, analogous to the external science review panel established for CalFed’s mercury program.

The TAC members should be independent, nationally- and/or internationally-recognized experts in their fields with a collective breadth of experience that enables them to evaluate the variety of methylmercury sources, water management practices, and processes that enhance methylation in the Delta region. The TAC members would provide advice on minimum criteria for study plans and as well as evaluate the study plans provided by the dischargers, mid-term and final study results, proposed management practices, potential redirected effects of the proposed management practices (e.g., on the function of wetlands and wastewater treatment processes), and pilot projects. The TAC members could also provide practical input about the relative feasibility of managing the different methylmercury sources (e.g., wetlands, WWTPs, urban runoff, agriculture, etc.) to help prioritize control actions for Phase 2 of the Delta mercury control program.

Dischargers could establish their own oversight committee(s) for designing and accomplishing the studies.

12. If levels of mercury in fish now are the same as levels measured 30 years ago, why does staff expect that goals of this plan are attainable?

Methylmercury levels in Delta fish are the same now as thirty years ago because there has been relatively little cleanup of legacy mercury in the Central Valley since the era of mercury and gold mining. Very few remediation actions have occurred within the past thirty years. Because these efforts were mostly upstream of major dams, the direct effect on mercury levels in the Delta has been very small. Wastewater treatment plants and industries have made upgrades during the past 30 years that, reduced their mercury discharges, and likely their methylmercury discharges, but there have been many changes in flow and hydrology in the Delta and tributaries that have had undetermined consequences in terms of mercury loading to the Delta.

Even so, staff expects that the goals of the proposed Delta mercury control program are attainable for three reasons. First, mercury cleanup actions elsewhere in the nation have produced decreases in methylmercury in fish. These controls have focused on reducing inorganic mercury, mainly through elimination of mercury transport into the water body and containment of mercury-polluted sediment. Because the Delta control program addresses both upstream inorganic mercury sources and local methylmercury sources, it is expected to result in more substantial and timely decreases in fish mercury levels. Second, the Central Delta subarea already meets the proposed fish tissue objectives and methylmercury goal for ambient Delta water. Thus, staff believes that the proposed fish tissue objectives and water goal are reasonable for other Delta subareas. Third, in a recent study by the USEPA and Oregon State University that analyzed 2,707 large TL3 and 4 fish from 626 streams and river segments in the western United States, about 30% to 40% of the sampled waterways supported a fish population with mercury concentrations lower than the proposed fish tissue objectives for large TL3 and TL4 fish in the Delta. (See Section 3.2.3 of the February 2008 BPA draft staff report for a more information about the study.) This indicates that the objective may be attainable with implementation of a vigorous control program.

13. Are laboratories available to conduct the mercury and methylmercury analysis?

There are several laboratories in California that use EPA method 1631 (Revision E) to analyze total mercury in water at detection limits (0.2 ng/l) acceptable for compliance with the requirements described in the proposed Basin Plan amendment. Dischargers have been sending samples to these laboratories on a routine basis for the past ten years.

In addition, several laboratories are capable of analyzing methylmercury using EPA method 1630 and can achieve a detection limit of 0.02 ng/l. Ambient water and effluent samples collected by Water Board staff, CalFed mercury researchers, and wastewater treatment plants during the past six years were analyzed at the following laboratories[1] in California and Washington:

- Private Laboratories:
  - CalTest (Napa, CA)
  - Battelle Marine Science Laboratory (Sequim, WA)
  - Brooks Rand (Seattle, WA)
  - Frontier GeoSciences (Seattle, WA)
  - Studio Geochimica (Seattle, WA)
- State Laboratories:
  - Moss Landing Marine Laboratories (Moss Landing, CA)
  - UC Santa Cruz (Flegal laboratory)

Staff anticipates that additional local laboratory services will become available and costs will drop as the requirements for methylmercury analysis become more common.

[1] Presence on the above list does not constitute endorsement by the Central Valley Water Board.